Cumulative AP Practice Test 3 Solutions

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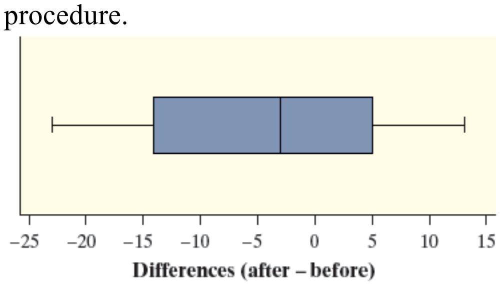
AP3.31 *State:* We want to perform a test of $H_0: \mu_d = 0$ versus $H_a: \mu_d < 0$ where μ_d is the true mean change in weight (after – before) in pounds for people like these who follow a five-week crash diet. We will use $\alpha = 0.05$. *Plan*: If conditions are met, we should do a paired *t* test for μ_d. Random: The data come from a random sample of dieters. 10%: $n_d = 15$ is less than 10% of all dieters. Normal/Large Sample: Because the number of differences is small, we need to graph the differences. There is no strong skewness or outliers, so it is reasonable to use a *t* procedure.



Do: The sample mean and standard deviation are: $\bar{x} = -3.6$ and $s_x = 11.53$. The test statistic is $t = \frac{-3.6 - 0}{11.53/\sqrt{15}} = -1.21$. With df = 15 – 1 = 14, the *P*-value is between 0.10 and 0.15. *Using technology*: *P*-value = 0.1232. *Conclude*: Because the *P*-value of 0.1232 is greater than α = 0.05, we fail to reject H_0. We do not have convincing evidence that the true mean change in weight (after – before) for people like these who follow a five-week crash diet is less than 0. That is, we do not have convincing evidence that dieters manage to not regain the weight they lose.

AP3.32 (a) This is an observational study. No treatments were imposed on the individuals in the study.
(b) We want to perform a test at the $\alpha = 0.05$ significance level of $H_0: p_1 - p_2 = 0$ versus $H_a: p_1 - p_2 < 0$ where p_1 is the true proportion of VLBW babies who graduate from high school by age 20 and p_2 is the true proportion of non-VLBW babies who graduate from high school by age 20. *Plan:* We should use a two-sample *z* test for $p_1 - p_2$ if the conditions are met. Random: The data come from independent random samples. 10%: $n_1 = 242$ is less than 10% of all VLBW babies and $n_2 = 233$ is less than 10% of all non-VLBW babies. Large Counts: The number of successes and failures in both groups are at least 10 (VLBW: 179 successes, 63 failures. Non-VLBW: 193 successes, 40 failures). *Do:* The proportions who graduated from high school in each group are $\hat{p}_1 = \frac{179}{242} = 0.740$ and $\hat{p}_2 = \frac{193}{233} = 0.828$. The pooled proportion is $\hat{p}_c = \frac{179+193}{242+233} = 0.783$, the test statistic is $z = \frac{(0.740 - 0.828) - 0}{\sqrt{\frac{(0.783)(0.217)}{242} + \frac{(0.783)(0.217)}{233}}} = -2.33$ and the *P*-value is $P(Z \le -2.33) = 0.0099$. *Using technology: z* = –2.33 and *P*-value = 0.0095. *Conclude:* Because the *P*-value of 0.0099 is less than α = 0.05, we reject H_0. We have convincing evidence that the true proportion of VLBW babies who graduate from high school by age 20 is less than the true proportion of non-VLBW babies who graduate from high school by age 20.

AP3.33 (a) $\hat{y}$ = –73.64 + 5.7188*x* where $\hat{y}$ = predicted distance and *x* = temperature (ºC)
(b) For each increase of one degree (C) in the water discharge temperature, the predicted distance from the nearest fish to the outflow pipe increases by about 5.7188 meters.
(c) Yes. The residual plot shows no leftover pattern and the original scatterplot shows a strong linear relationship between temperature of the discharge water and the distance of the fish from the outflow pipe.
(d) The predicted distance is $\hat{y}$ = –73.64 + 5.7188(29) = 92.21 meters. The residual is $y - \hat{y}$ = 78 – 92.21 = –14.21 meters. The actual distance on this afternoon was 14.21 meters closer than expected, based on the temperature of the water.

AP3.34 Define *W*= the weight of a randomly selected gift box. Then, $\mu_W = 2+2+2+2+2+2+2+2+4+4+3 = 8(2)+2(4)+3 = 27$ ounces and

$$\sigma_W = \sqrt{0.5^2+0.5^2+0.5^2+0.5^2+0.5^2+0.5^2+0.5^2+0.5^2+1^2+1^2+0.2^2}$$
$$= \sqrt{8(0.5^2)+2(1^2)+0.2^2} = 2.01 \text{ ounces.}$$

(b) **Step 1: State the distribution and values of interest.** Because the distribution of each type of item is Normal, the distribution of W will also be Normal, with mean 27 ounces and standard deviation 2.01 ounces. We want to find $P(W > 30)$. **Step 2: Perform calculations. Show your work.** The standardized score for the boundary value is $z = \frac{30-27}{2.01} = 1.49$. From Table A, the proportion of z-scores above 1.49 is 1 – 0.9319 = 0.0681. *Using technology:* The command normalcdf(lower: 30, upper: 1000, μ: 27, σ: 2.01) gives an area of 0.0678. **Step 3: Answer the question.** There is a 0.0678 probability of randomly selecting a box that weighs more than 30 ounces.
(c) P(at least one box is greater than 30 ounces) = 1 – P(none of the boxes is greater than 30 ounces) = $1 - (1 - 0.0678)^5 = 1 - (0.9322)^5 = 0.2960$. There is a 0.2960 probability of selecting a random sample of 5 boxes and having at least one box weigh more than 30 ounces.
(d) **Step 1: State the distribution and values of interest.** Because the distribution of W is Normal, the distribution of $\overline{W}$ will also be Normal, with mean $\mu_{\overline{W}} = \mu_W = 27$ ounces and standard deviation $\sigma_{\overline{W}} = \frac{\sigma_W}{\sqrt{n}} = \frac{2.01}{\sqrt{5}} = 0.899$. We want to find $P(\overline{W} > 30)$. **Step 2: Perform calculations. Show your work.** The standardized score for the boundary value is $z = \frac{30-27}{0.899} = 3.34$. From Table A, the proportion of z-scores above 3.34 is 1 – 0.9996 = 0.0004. *Using technology:* The command normalcdf(lower: 30, upper: 1000, μ: 27, σ: 0.899) gives an area of 0.0004. **Step 3: Answer the question.** There is a 0.0004 probability of randomly selecting 5 boxes that have a mean weight of more than 30 ounces.

AP3.35 (a) *State:* We want to perform a test at the $\alpha = 0.05$ significance level of $H_0: \mu_A - \mu_B = 0$ versus $H_a: \mu_A - \mu_B \neq 0$ where μ_A is the true mean annualized return for stock A and μ_B is the true mean annualized return for stock B. *Plan:* We should use a two-sample t test if the conditions are met. Random: These data come from independent random samples. 10%: $n_A = 50$ is less than 10% of all days in the past 5 years and $n_B = 50$ is less than 10% of all days in the past 5 years. Normal/Large Sample: $n_A = 50 \geq 30$ and $n_B = 50 \geq 30$. *Do:* The test statistic is $t = \frac{(11.8 - 7.1) - 0}{\sqrt{\frac{(12.9)^2}{50} + \frac{(9.6)^2}{50}}} = 2.07$. The conservative degrees of freedom is 50 – 1 = 49. Using Table B and df = 40, the P-value is between 2(0.02) = 0.04 and 2(0.025) = 0.05. *Using technology*: t = 2.07, df = 90.53, P-value = 0.0416. *Conclude:* Because the P-value of 0.0416 is less than α = 0.05, we reject H_0. We have convincing evidence that the true mean annualized return for stock A is different than the true mean annualized return for stock B.
(b) $H_o: \sigma_A - \sigma_B = 0$ versus $H_a: \sigma_A - \sigma_B > 0$ where σ_A is the true standard deviation of returns for stock A and σ_B is the true standard deviation of returns for stock B.
(c) When the standard deviation of stock A is greater than the standard deviation of stock B, the variance of stock A will be bigger than the variance of stock B. Thus, values of F that are significantly greater than 1 would indicate that the price volatility for stock A is higher than that for stock B.
(d) $F = \frac{(12.9)^2}{(9.6)^2} = 1.806$.

(e) In the simulation, a test statistic of 1.806 or greater occurred in only 6 out of the 200 trials. Thus, the approximate *P*-value is 6/200 = 0.03. Because the approximate *P*-value of 0.03 is less than α = 0.05, we reject H_0. There is convincing evidence that the true standard deviation of returns for stock A is greater than the true standard deviation of returns for stock B.